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[54] CAPSULE FILLING APPARATUS

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[52] **U.S. Cl.** **53/499**; 53/57; 53/900

[58] **Field of Search** 53/499, 497, 498, 493, 53/494, 57, 56, 55, 52, 900, 284.5, 281, 282, 283; 493/9

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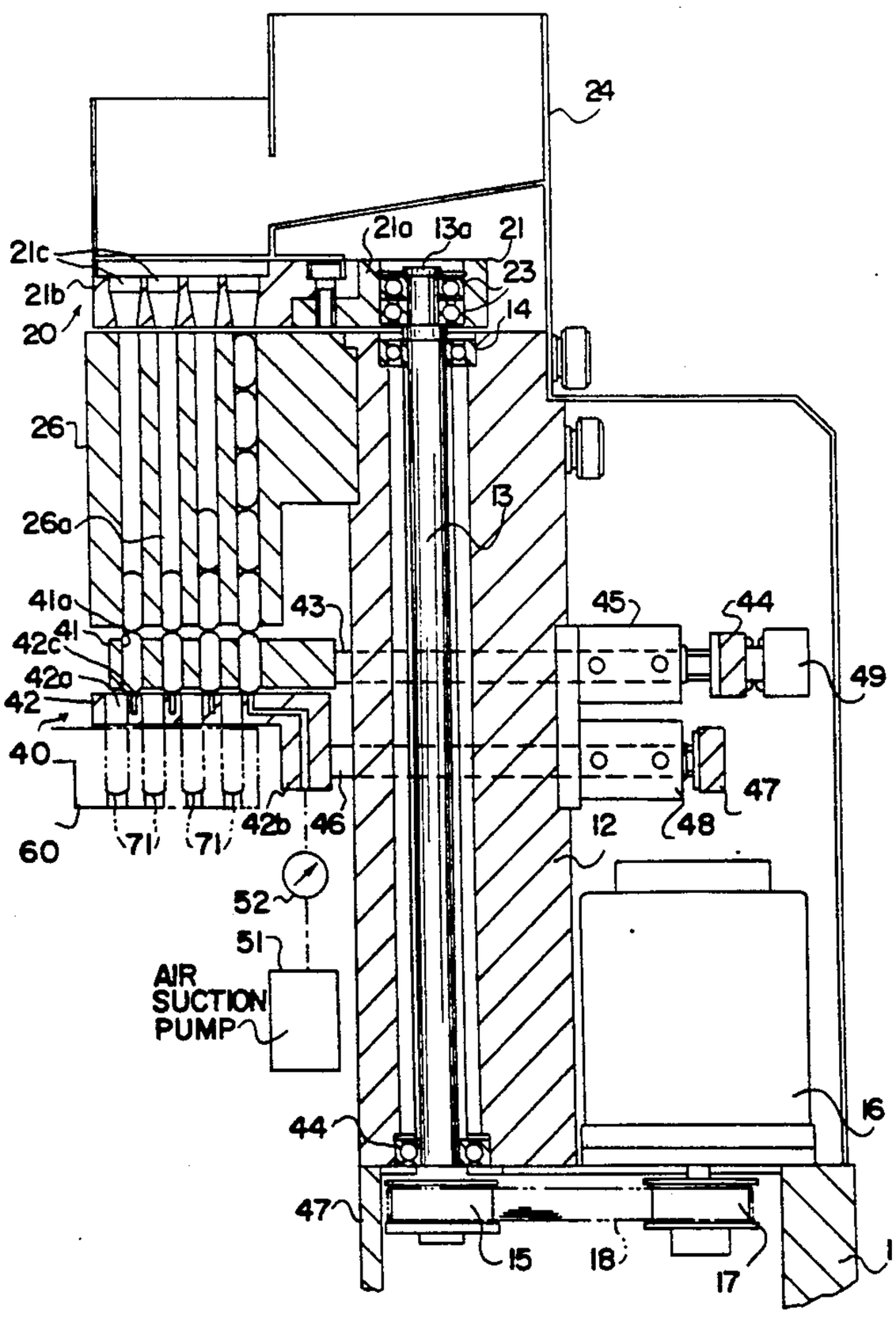
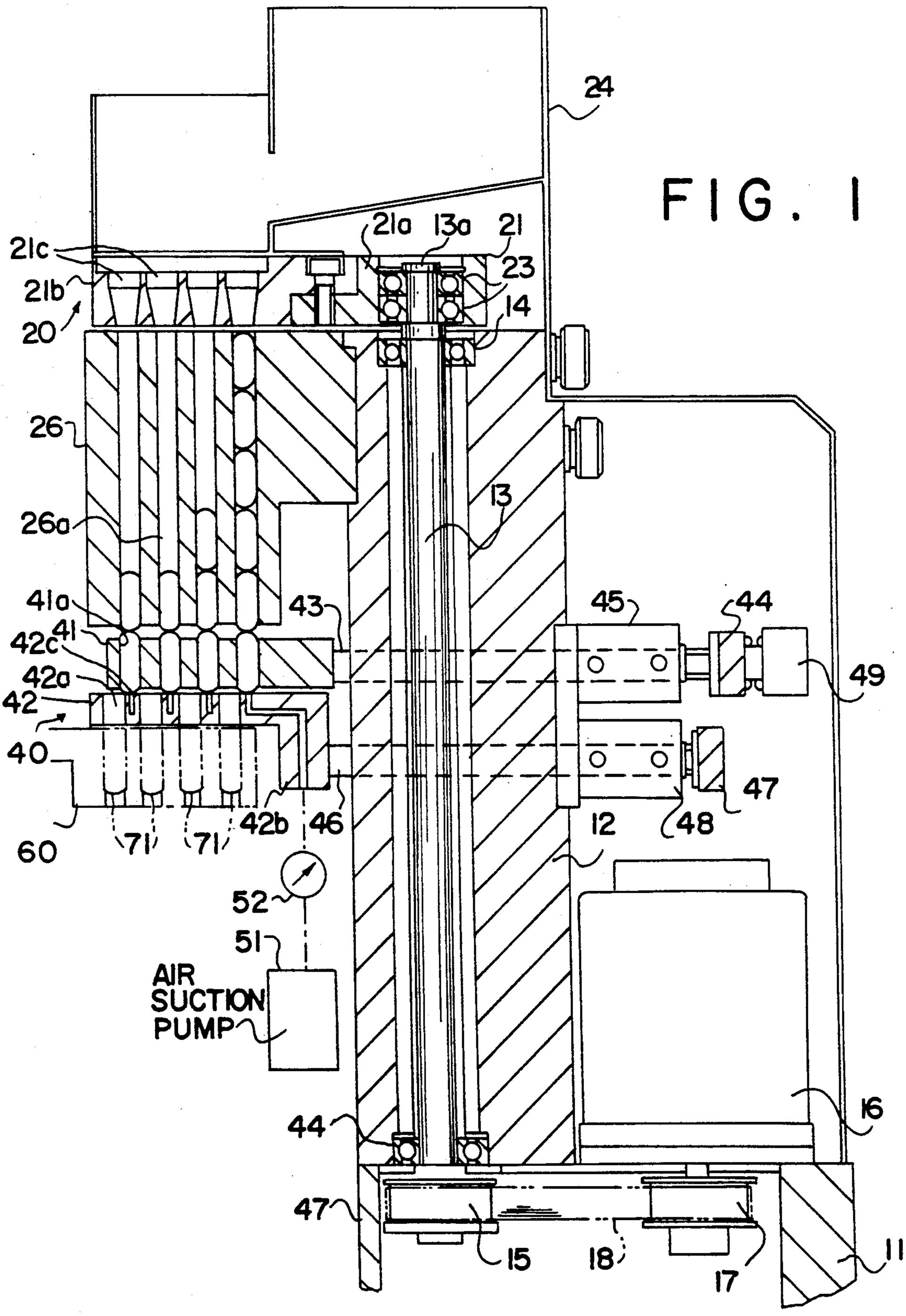
[57] **ABSTRACT**

A capsule filling apparatus which fills capsules with tablets having the same cylindrical shape as the capsules, wherein each tablet is fed from a hopper in an upright posture and wherein the filling of tablets into the capsules is secured by detecting a pressure varying depending on the presence of tablets in delivering holes.

6 Claims, 2 Drawing Sheets

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21a
13a
21
21c
23
21b
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20
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26a
41a
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42c
42a
49
42
40
47
12
48
60
71
71
42b
46
52
51
AIR SUCTION PUMP
16
44
47
15
18
17
11

FIG. 1

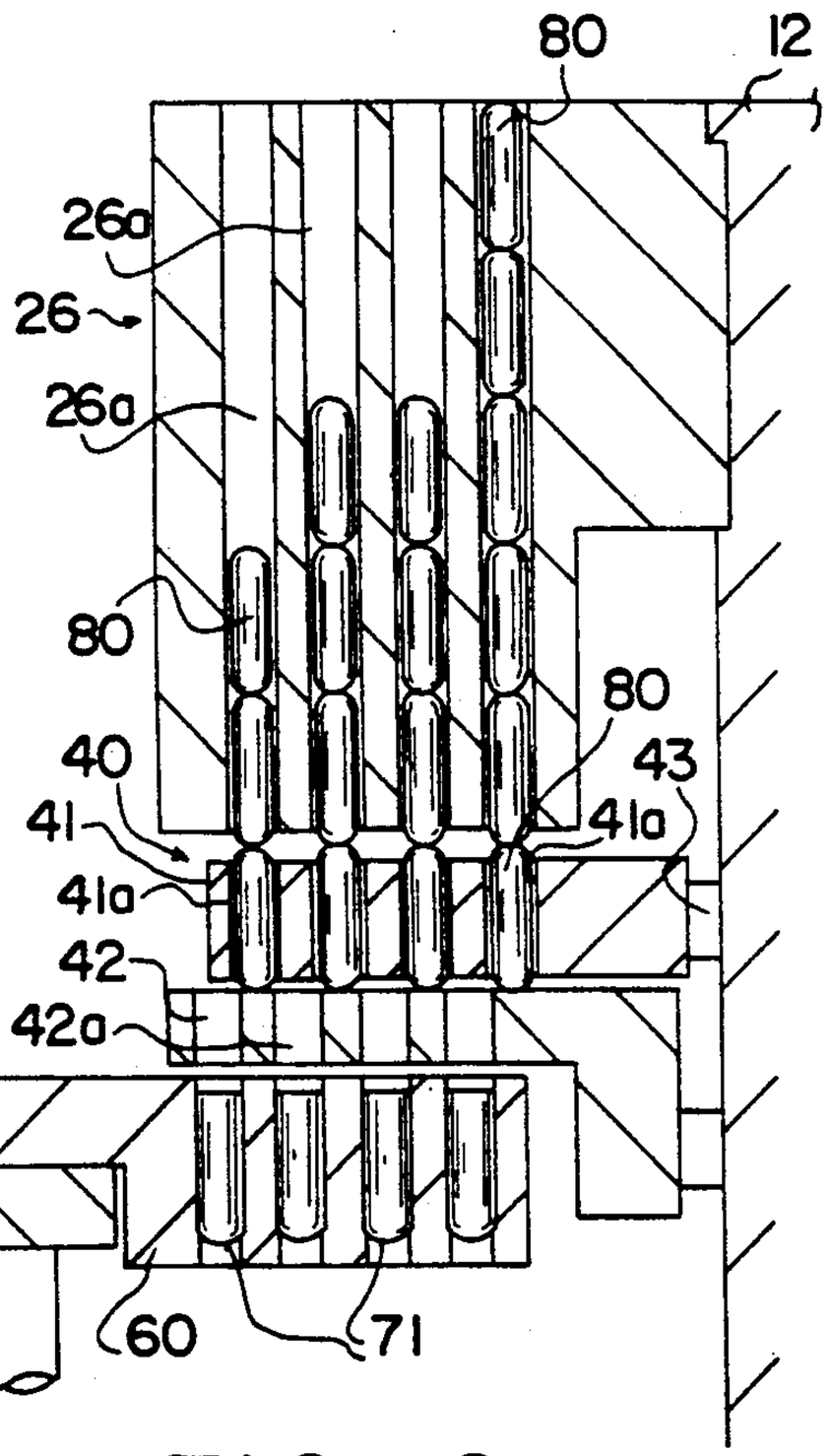
80
12
26a
26
26a
80
80
40
43
41
41a
41a
42
42a
60
71

FIG. 2

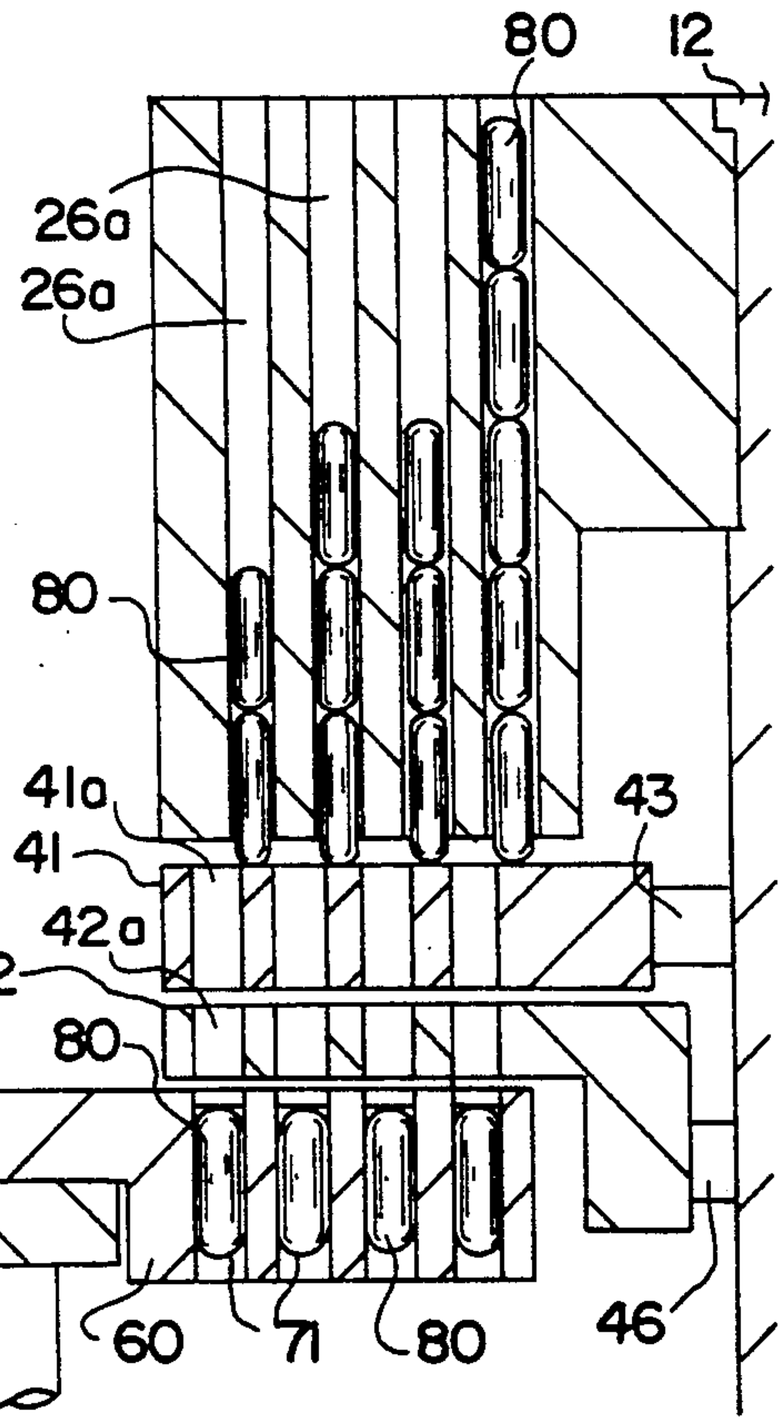
80
12
26a
26a
80
41a
43
41
42a
42
80
60
71
80
46

FIG. 3

CAPSULE FILLING APPARATUS

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to a capsule filling apparatus, and more particularly to an apparatus for filling rigid capsules made of gelatin with tablets of the same cylindroidal shape as the capsule, wherein the capsules were held in an upright posture with the openings upward.

2. Description of the Prior Art

It is common practice to fill a rigid capsule made of gelatin with a fluid substance such as granular, powder or liquid medicine. Sometimes, such capsules are also filled with solid tablets, and in recent years, with tablets having the same cylindroidal shape as the capsule itself. Being covered with the capsule in this way, the tablet can be protected from damage or deformation. This is also advantageous in eliminating the necessity of putting identification marks or coloring directly upon the tablets but only putting it on the capsules themselves.

Japanese Laid-Open Patent Publication No. 52-39494 discloses an apparatus for filling a capsule with a disk-shaped tablet. In this capsule filling apparatus, a disk-shaped tablet fed into a chute is passed into a hole extending through a slider. The slider is then moved in the horizontal direction so as to send the tablet held inside the hole through a hole in a shutter into a capsule. The filling of the capsule is detected by the displacement of a detecting rod to be inserted in the capsule.

When a capsule is filled with a tablet having the same shape as the capsule, the tablet must be inserted upright into the capsule which is also held upright. It is difficult, however, to form a sequence of upright cylindroidal tablets in a vertical line. Tablets may not be fed continuously into capsules through the hole in the slider, thereby resulting in the failure of filling the capsules with them. The problem of empty capsules sometimes occurs. To solve this problem, care must be taken to maintain the supply of tablets into capsules.

The above-mentioned capsule filling apparatus employs a detecting rod which is inserted into a capsule after the capsule is filled with a tablet. The filling of the tablet is detected by the displacement of the detecting rod. In this arrangement, however, the detecting rod touches the tablet and may damage it. Moreover, ingredients of the tablet may stick to the tip of the detecting rod, which must be cleaned before a different kind of tablet is charged in the capsule.

Furthermore, when the capsule is filled with a capsule-shaped tablet, the upright tablet may not completely fit into the hole of the slider, and is likely to be suspended between the chute and the slider. When the slider is moved under this condition, the tablet may be cut off by a shearing force applied between the hole of the slider and the chute.

SUMMARY OF THE INVENTION

The capsule filling apparatus of this invention, which overcomes the above-discussed and numerous other disadvantages and deficiencies of the prior art, comprises a first tablet feed part for feeding tablets into a hopper one by one in an upright posture, a slider disposed below the first tablet feed part, the slider having holes each extending therethrough so as to allow the tablets fed from the first tablet feed part to pass therethrough, and a shutter disposed below the slider, the shutter having guiding holes each extending therethrough and facing at the bottom end each opening of the capsule body so as to allow the tablets fed from the slider to pass therethrough, and means for detecting whether the tablets are properly placed in the holes of the slider, the slider horizontally moving to enable the bottom end of each hole thereof to be positioned one time to face each guiding hole of the shutter and the other to face each means for detecting the tablets in the holes.

In a preferred embodiment, the means for detecting the tablets of the shutter comprises air suction tubes each provided with an air suction opening at the top thereof, the air suction opening having a smaller diameter than that of the tablet, pressure sensors for detecting the internal pressure of the air suction tubes, and an air suction pump for reducing the internal pressure of the air suction tubes.

In a preferred embodiment, the shutter is made movable in the same direction as the slider.

In a preferred embodiment, the first tablet feed part is attached to an eccentric portion of a rotation axis.

In a preferred embodiment, the hopper disposed in the first tablet feed part is oscillated in the horizontal direction.

In a preferred embodiment, the first tablet feed part includes a feed block having holes shaped like a truncated cone whose top opening is larger than the bottom opening, the diameter of the top opening being smaller than the length of the tablet, whereas that of the bottom opening larger than the width thereof.

Thus, the capsule filling apparatus described herein makes possible the objectives of (1) filling the capsule with a tablet of the same shape as the capsule smoothly and continuously by oscillating the hopper so that the tablets can be fed from the hopper without being caught, and (2) ensuring to detect whether the capsule body is completely filled with the tablet without damaging the tablet.

BRIEF DESCRIPTION OF THE DRAWINGS

This invention may be better understood and its numerous objects and advantages will become apparent to those skilled in the art by reference to the accompanying drawings as follows:

FIG. **1** is a sectional view of a main part of one embodiment of the capsule filling apparatus according to the present invention;

FIG. **2** and FIG. **3** are partial sectional views illustrating the operation of the embodiment of FIG. **1**, respectively.

DESCRIPTION OF THE PREFERRED EMBODIMENT

One embodiment according to the present invention is described as follows.

The capsule filling apparatus of this invention is used to fill a rigid capsule with a tablet of the same cylindroidal shape as the capsule. The capsule is formed of a cylindroidal capsule body and a capsule cap each with an opening at one end, and at the filling the capsule cap is separated from the capsule body. Before being filled with tablets by the capsule filling apparatus according to the present invention, a group of capsules are set in an array, by means of, for example, the capsule direction regulating mechanism disclosed in Japanese Laid-Open Patent Publication No. 61-211213, in such a manner that

each capsule is placed upright with the capsule cap upward and the capsule body and capsule cap loosely connected so as to be easily separated from each other afterwards and still keeping the orderly array of the capsules. Then, the array of capsule bodies with a fixed space between them are conveyed in the horizontal direction to a fixed place by means of an annular capsule body conveying mechanism **60** disposed horizontally as shown in FIG. **1**. The capsule bodies in the array are regularly arranged like a checkerboard.

The capsule filling apparatus according to the present invention is mounted on the side of the fixed place of the capsule body conveying mechanism **60** as shown in FIG. **1**.

The capsule filling apparatus comprises a cylindrical support **12** vertically held onto a hollow base **11**. At the upper portion of the support **12** is located a first feed part **20** which is supported by the support **12** and includes a hopper **24** for receiving tablets and a guide block **26** for guiding the tablets so that they are fed in an upright posture from the hopper **24**. The guide block **26** is disposed to correspond to the fixed place of the capsule body conveying mechanism **60**. Between the guide block **26** and the capsule body conveying mechanism **60** is located a second tablet feed part **40**.

Through the cylindrical support **12** extends a rotation axis **13**, of which top and bottom portions are rotatably secured to the top and bottom portions of the support **12** through bearings **14** and **44**, respectively. The bottom portion of the rotation axis **13** extends beyond the bottom end of the support **12** to reach the inside of the base **11**. A pulley **15** is connected around the extended bottom portion of the rotation axis **13**. A motor **16** is mounted on the base **11** at the opposite side to the capsule body conveying mechanism **60** with respect to the support **12**, so that its output axis is positioned in the vertical direction and extends downward into the base **11**. A pulley **17** is connected around the extended bottom portion of the output axis. Between this pulley and the pulley **15** connected around the rotation axis **13** is wound a belt **18**, so that the rotation generated by the motor **16** is transmitted to the rotation axis **13** through the belt **18**.

The top portion of the rotation axis **13** extends beyond the top end of the support **12**, and the extended portion of the rotation axis **13** forms an eccentric portion **13***a*. To the eccentric portion **13***a* is attached an oscillating portion **21** of the first tablet feed part **20**.

The oscillating portion **21** includes a coupling block **21***a* disposed around the eccentric portion **13***a* and a feed block **21***b* horizontally supported by the coupling block **21***a*. The eccentric portion **13***a* is slightly made eccentric against the other portion of the rotation axis **13** secured within the support **12**. The coupling block **21***a* is rotatably fitted around the eccentric portion **13***a* through a pair of bearings **23**, causing the entire oscillating portion **21** to slightly oscillate in the horizontal direction when the rotation axis **13** rotates.

The hopper **24** is mounted on the feed block **21***b* supported by the coupling block **21***a*. Into the hopper **24** are supplied tablets **80** of the same cylindroidal shape as the capsule. The tablets **80** move within the hopper toward the area above the feed block **21***b*.

The feed block **21***b* is horizontally placed above the capsule body conveying mechanism **60**. A plurality of holes **21***c* extend through the feed block **21***b* in the same arrangement as the array of capsule bodies **71** on the mechanism **60** so that each hole **21***c* corresponds to each capsule body **71**. Each hole **21***c*, with the vertical axis, is shaped like a truncated cone with its top opening larger than its bottom opening. The top opening of the hole **21***c* has a diameter slightly smaller than the length of the capsule-shaped tablet **80**, while the bottom opening thereof has a diameter slightly larger than the width of the tablet **80**. When the oscillating portion **21** is oscillated through the rotation of the rotation axis **13**, each tablet **80** in the hopper **24** starts to enter each hole **21***c* with a longitudinal end of the tablet ahead.

A number of chutes **26***a* extend through the guide block **26** attached to the upper portion of the support **12**. The top end of each chute **26***a* roughly faces the bottom end of each hole **21***c* of the feed block **21***b*. The diameter of each chute **26***a* is slightly larger than the width of the tablet **80**, so that the tablets **80** which have passed through the holes **21***c* are introduced one after another to the chutes **26***a* in a roughly upright posture. Each chute **26***a* is arranged to accommodate several upright tablets **80** (five in this embodiment) in a line.

The second tablet feed part **40** located below the guide block **26** includes a slider **41** horizontally disposed below the guide block **26** and a shutter **42** horizontally disposed below the slider **41**. The slider **41** is supported by a pair of support axes **43** which horizontally extend through the support **12**. The ends of the support axes **43** opposite the ones attached to the slider **41**, which are located above the motor **16**, are connected to each other by means of a coupling rod **44**. Between the center portion of the coupling rod **44** and the support **12** is horizontally disposed an air cylinder **45**, which operates to push the coupling rod **44** to move toward or away from the support **12**, causing the synchronous parallel movement of the pair of support axes **43** in the horizontal direction.

To the air cylinder **45** is attached a load sensor **49** for detecting a high load applied to the air cylinder **45**.

The slider **41** supported by the support axes **43** is provided with a number of holes **41***a* vertically extending therethrough. These holes **41***a* are formed in the same arrangement as the chutes **26***a* of the guide block **26** and accept the tablets **80**. The length of each hole **41***a* is made slightly smaller than the length of the tablet **80**. When the slider **41** moves toward the support **12** by the operation of the air cylinder **45**, each hole **41***a* faces the bottom end of each chute **26***a* in an aligned condition. Meanwhile, when the slider **41** moves away from the support **12**, the upper surface between the holes **41***a* of the slider **41** faces the bottom end of each chute **26***a*.

The shutter **42** disposed below the slider **41** is supported by a pair of support axes **46** horizontally extending through the support **12** in the same manner a the slider **41**. The ends of the support axes **46** located above the motor **16** are connected to each other by means of a coupling rod **47**. Between the center portion of the coupling rod **47** and the support **12** is horizontally disposed an air cylinder **48**, which operates to push the coupling rod **47** to move toward or away from the support **12**, causing the synchronous parallel movement of the pair of support axes **46** in the horizontal direction.

The shutter **42** is provided with a number of guide holes **42***a* vertically extending therethrough. These guide holes **42***a* are formed in the same arrangement as the holes **41***a* of the slider **41** and the chutes **26***a* of the guide block **26**. Normally, each guide hole **42***a* is made to face each hole **41***a* of the slider **41** when the slider **41** above the shutter **42** moves away from the support **12**.

The shutter **42** is also provided with air suction openings **42***c* for air suction tubes **42***b*, each facing the axis portion of each hole **41***a* of the slider **41** when the slider **41** is moved toward the support **12**. Each air suction opening **42***c* is made sufficiently smaller than the chute **26***a* in diameter to prevent the capsule-shaped tablet from entering the air suction opening. The air suction tubes **42***b* extend through the shutter **42** so as not to communicate with any of the guide holes **42***a*, and are connected to an air suction pump **51** at the ends. At a point along each air suction tube **42***b* is disposed a pressure sensor **52** which detects air pressure inside the air suction tube **42***b*.

The operation of the thus arranged capsule filling apparatus is described as follows.

When the capsule-shaped tablet **80** has been put in the hopper **24** of the first tablet feed part **20**, the array of capsule bodies on the capsule body conveying mechanism **60** is brought below the second tablet feed part **40**. At this time, both the slider **41** and the shutter **42** of the second tablet feed part **40** have been moved away from the support **12**. (Refer to FIG. **3**.) Under the above conditions, each capsule body **71** held on the capsule body conveying mechanism **60** with its opening upward faces each guide hole **42***a* of the shutter **42**. The top end of each hole **41***a* of the slider **41** does not face the bottom end of each chute **26***a* of the guide block **26**, which is therefore closed by the upper surface of the slider **41**, while the lower end of each hole **41***a* of the slider **41** faces each guide hole **42***a* of the shutter **42**.

First, under the above described conditions, the motor **16** is driven to initiate the rotation of the rotation axis **13** which extends through the support **12**. Then, the eccentric portion **13***a* formed on the top portion of the rotation axis **13** is eccentrically rotated, causing the oscillating portion **21** attached to the eccentric portion **13***a* to oscillate in the horizontal direction. This horizontal oscillation is transmitted to the hopper **24** mounted on the oscillating portion **21**, giving vibration to the tablets **80** inside the hopper **24**. The vibrated capsule-shaped tablets **80** in the hopper **24** then start to enter each hole **21***c* of the feed block **21***b* one by one with a longitudinal end of the tablet ahead. The tablets **80** thus made to stand in an upright posture through each hole **21***c* then fall one by one into each chute **26***a* of the guide block **26**, forming a continuous line of upright tablets in each chute **26***a* as the bottom end thereof is closed by the upper surface of the slider **41** at this time.

Second, the air cylinder **45** is driven so as to cause the slider **41** of the second tablet feed part **40** to horizontally move toward the support **12**. Hence, as shown in FIG. **2**, each hole **41***a* of the slider **41** faces each chute **26***a* of the guide block **26** at the top end and faces each air suction opening **42***c* of the shutter **42** at the bottom end. Under this positioning, the tablet **80** placed on the bottom of each chute **26***a* of the guide block **41** falls into the hole **41***a* of the slider **41** by its own weight. As the bottom end of each hole **41***a* of the slider **41** faces each air suction opening **42***c* of the shutter **42**, the tablet **80** is not passed through but held within the hole **41***a*. At this time, the bottom end of the tablet **80** closes the air suction opening **42***c*.

Third, the air suction pump **51** connected to the air suction tubes **42***b* is used to reduce the pressure inside the air suction tubes **42***b*. When the air suction opening **42***c* is closed by the bottom end of the tablet **80**, air will not enter from the air suction opening **42***c* and the internal pressure of the air suction tube **42***b* is reduced. Therefore, when all of the holes **41***a* of the slider **41** are filled with tablets **80** closing all of the air suction openings **42***c*, the internal pressure of the air suction tubes **42***b* decreases to a prescribed degree. On the other hand, when any of the holes **41***a* is not filled with the tablet **80**, the air suction opening **42***c* facing the hole **41***a* is not closed by the tablet **80**, allowing the air flow through the air suction tube **42***b* and thus failing to decrease the internal pressure thereof to the prescribed degree. The pressure sensors **52** disposed in the air suction tubes **42***b* detect the internal pressure of the air suction tubes **42***b* to determine whether all of the holes **41***a* of the slider **41** are filled with the tablets **80**.

Incidentally, when any hole **41***a* of the slider **41** is not filled with the tablet **80**, the tablet **80** placed in the chute **26***a* of the guide block **26** may be sucked into the hole **41***a* by the air suction at the air suction opening **42***c*.

Fourth, the air cylinder **45** is used to allow the slider **41** to horizontally move away from the support **12**. This causes the bottom end of each hole **41***a* of the slider **41** to face each guide hole **42***a* of the shutter **42**. As shown in FIG. **3**, the capsule-shaped tablet **80** held in each hole **41***a* of the slider **41** then falls through each guide hole **42***a* of the shutter **42** into each capsule body **71** held on the capsule body conveying mechanism **60**. At this moment, the upper surface of the slider **41** closes the bottom end of each chute **26***a* of the guide block **26**, not allowing the bottom tablet **80** in each chute **26***a* to fall into each hole **41***a*.

In the case where the tablet **80** held in the hole **41***a* of the slider **41** has not completely fallen into the guide hole **42***a* of the shutter **42** but is suspended between the two holes, the air cylinder **45** is heavily loaded when the slider **41** starts again to move toward the support **12**. The load sensor **49** detects this loading and operates to initiate the air cylinder **48**, which moves the shutter **42** toward the support **12**, thus allowing the tablet **80** suspended between the two holes to fall into the guide hole **42***a* so as to be discharged. At this time, the capsule body conveying mechanism **60** has been moved away from the fixed place below the shutter **42**.

Thus, when each capsule body **71** in the array on the fixed place of the capsule body conveying mechanism **60** completes the filling, the capsule body conveying mechanism **60** is driven to set a new array of empty capsule bodies on the fixed position below the second tablet feed part **40**, and the same steps as described above are repeated.

It is understood that various other modifications will be apparent to and can be readily made by those skilled in the art without departing from the scope and spirit of this invention. Accordingly, it is not intended that the scope of the claims appended hereto be limited to the description as set forth herein, but rather that the claims be construed as encompassing all the features of patentable novelty that reside in the present invention, including all features that would be treated as equivalents thereof by those skilled in the art to which this invention pertains.

What is claimed is:

1. A capsule filling apparatus for filling a capsule body held in an upright posture with the opening upward with a tablet of the same cylindroidal shape as the capsule comprising:

a first tablet feed part for feeding tablets into a hopper one by one in an upright posture;

a slider disposed below the first tablet feed part, the slider having holes each extending therethrough so

as to allow the tablets fed from the first tablet feed part to pass therethrough; and

a shutter disposed below the slider, the shutter having guiding holes each extending therethrough and facing at the bottom end each opening of the capsule body so as to allow the tablets fed from the slider to pass therethrough, and means for detecting whether the tablets are properly placed in the holes of the slider, the slider horizontally moving to enable the bottom end of each hole thereof to be positioned one time to face each guiding hole of the shutter and the other to face each means for detecting the tablets in the holes.

2. A capsule filling apparatus according to claim **1**, wherein the means for detecting the tablets of the shutter comprises air suction tubes each provided with an air suction opening at the top thereof, the air suction opening having a smaller diameter than that of the tablet, pressure sensors for detecting the internal pressure of the air suction tubes, and an air suction pump for reducing the internal pressure of the air suction tubes.

3. A capsule filling apparatus according to claim **1**, wherein the shutter is made movable in the same direction as the slider.

4. A capsule filling apparatus according to claim **1**, wherein the first tablet feed part is attached to an eccentric portion of a rotation axis.

5. A capsule filling apparatus according to claim **1**, wherein the hopper disposed in the first tablet feed part is oscillated in the horizontal direction.

6. A capsule filling apparatus according to claim **1**, wherein the first tablet feed part includes a feed block having holes shaped like a truncated cone whose top opening is larger than the bottom opening, the diameter of the top opening being smaller than the length of the tablet, whereas that of the bottom opening larger than the width thereof.

* * * * *